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EXAMINER	
THOMPSON, JAMES A	

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2625	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	09/896,798	LUO ET AL.	
	Examiner	Art Unit	
	James A. Thompson	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 March 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) _____ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *16 and 18-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see page 5, lines 7-15, filed 08 March 2007, with respect to the rejections under 35 USC §101 have been fully considered and are persuasive. The rejections under 35 USC §101 have been withdrawn.

2. Applicant's arguments filed 08 March 2007 have been fully considered but they are not persuasive. The amendments to the claims have been fully considered by Examiner and are considered to be rendered obvious by the prior art of record, as set forth in detail below. With respect to claim 16, it is the *combination* of Murayama (USPN 5,936,684) in view of Revankar (USPN 5,649,025) that teaches the newly amended limitation "wherein throughout the repeated revising of said K clusters, the number of clusters K does not change". With respect to claim 21, the combination of Murayama in view of Revankar teaches that new values of clusters are calculated. By performing the recursive revision of threshold values, as taught by Revankar, in the system of Murayama, the K clusters taught by Murayama are repeatedly revised.

Some new grounds of rejection, which have been necessitated by the present amendments to the claims, are provided below. Since the new grounds of rejection are necessitated by the present amendments, the present rejection is made final.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. **Claims 16 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025).**

Regarding claim 16: Murayama discloses a method (figure 10 of Murayama) for multitone processing an N level digital image to produce an M level digital image (figure 4 and column 9, lines 34-39 of Murayama) wherein M and N have unchanging values and $M<N$ (e.g., $M=4$, $N=256$), comprising

the steps of clustering all of the pixel values (figure 1(S1-S4) of Murayama) of the N level image into M (M<N) reconstruction levels (column 8, lines 23-32 of Murayama) based on the gray level distribution of the N level image (figures 2a-2b; figure 4; and column 9, lines 34-45 of Murayama), wherein the clustering produces K clusters of pixel values (figure 4 and column 8, lines 39-43 of Murayama), and wherein K=M (4 clusters (K) and M=4); and minimizing error between the N level digital image and the M level digital image during said clustering (figure 2b; column 8, lines 44-49; and column 10, lines 22-24 and equation 5 of Murayama). Said error is minimized as a part of the process of clustering. The even distribution of the threshold values based on the cumulative histogram (figure 2b and column 8, lines 44-49 of Murayama) and the maximization of the interclass variance (column 10, lines 22-24 and equation 5 of Murayama), which also distributes the threshold values as evenly as possible, minimizes the error between the N level digital image and the M level digital image during said clustering.

Murayama further discloses that the number of clusters K is set constant, and thus does not change (column 8, lines 37-43 of Murayama – *number of thresholds (which is one less than the number of clusters) is set based on the number of levels produced (M) which is unchanging*); and applying multilevel error diffusion (figure 1(S5) of Murayama) to the N level digital image using said M reconstruction levels to produce the M level digital image (column 14, lines 56-62 of Murayama). A part of the n value conversion (figure 1(S5) of Murayama) is the application of multilevel error diffusion (column 14, lines 56-62 of Murayama).

Murayama further discloses applying said M level digital image to an image output device (figure 6("OUTPUT") and column 10, line 66 to column 11, line 2 of Murayama).

Murayama does not disclose expressly repeatedly revising said K clusters of said pixel values until error between the N level digital image and the M level digital image is minimized, wherein throughout the repeated revising of said K clusters, the number of clusters K does not change.

Revankar discloses repeatedly revising the threshold values (and thus K clusters *as per* the teachings of Murayama) of pixel values (figure 6(304,306) and column 6, lines 56-65 of Revankar) until a predetermined stopping condition is reached (column 6, line 64 to column 7, line 5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform the clustering taught by Murayama, iteratively and until a predetermined stopping condition is reached, as taught by Revankar, which would be the minimum error taught by Murayama. The error minimization taught by Murayama minimizes said error in terms of only one iteration of said clustering. With repeated iterations of said clustering, which would

inherently occur after the first said clustering, said error would be minimized using the stopping condition criteria, as taught by Revankar. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar), and it would have been clear to one of ordinary skill in the art at the time of the invention that minimizing error in image document reproduction is desirable. Furthermore, Murayama teaches that the number of clusters K is set constant, and thus does not change, as discussed above. Thus, throughout the repeated revising of said K clusters (by iteratively performing the clustering taught by Murayama), the number of clusters K does not change. Therefore, it would have been obvious to combine Revankar with Murayama to obtain the invention as specified in claim 16.

Regarding claim 21: Murayama discloses a method for multi-tone processing an N level digital image to produce an M level digital image (figure 4 and column 9, lines 34-39 of Murayama) wherein M and N have unchanging values and M<N (e.g., M=4, N=256), comprising the steps of: assigning pixels of the N level digital image to the M cluster centers to provide assigned pixels (column 8, lines 44-49 of Murayama); calculating values of said cluster centers based upon respective said assigned pixel (figure 4 and column 9, lines 34-45 of Murayama); selecting final values of said cluster centers as reconstruction levels (figure 4 and column 9, lines 34-39 of Murayama); applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image using said reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama); and applying said M level digital image to an image output device (figure 6("OUTPUT") and column 10, line 66 to column 11, line 2 of Murayama).

Murayama does not disclose expressly setting initial values of M cluster centers; and repeating said assigning and said calculating until a predetermined stopping condition is reached and, thereby, final values of said cluster centers are defined.

Revankar discloses setting initial values of M thresholds (and thus M cluster centers *as per* the teachings of Murayama) (column 5, lines 6-9 of Revankar); and repeating the overall threshold operations (figure 6(304, 306) and column 6, lines 56-65 of Revankar) until a predetermined stopping condition is reached (column 7, lines 1-5 of Revankar) and, thereby, final values of said thresholds (and thus cluster centers *as per* the teachings of Murayama) are defined (column 7, lines 1-5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to iteratively perform the threshold determination, as taught

by Revankar, thus initially setting the value of the M cluster centers and repeating said assigning and calculating steps taught by Murayama until a predetermined stopping condition is reached, as taught by Revankar. This would also result in the calculating step taught by Murayama being a step of calculating *new* values, since initial values are already set according to the teachings of Revankar. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar). Therefore, it would have been obvious to combine Revankar with Murayama to obtain the invention as specified in claim 21.

Regarding claim 22: Murayama discloses that said assigning minimizes respective mean squared error (figure 5(S23) and column 10, lines 22-24 and equation 5 of Murayama). Maximizing the interclass variance (figure 5(S23) and column 10, lines 22-24 and equation 5 of Murayama), distributes the threshold values as evenly as possible. Since the equation for variance is based on the square of the difference between the respective classes (figure 5(23) and column 10, equation 5 of Murayama), the respective mean squared error is minimized.

Regarding claim 23: Murayama discloses that the stopping condition is a predetermined threshold (column 8, lines 23-29 of Murayama). After the [n-1]th threshold has been determined, the threshold determination is stopped (column 8, lines 23-29 of Murayama).

5. Claims 18 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Ishiguro (US Patent 6,501,566 B1).

Regarding claim 18: Murayama in view of Revankar does not disclose expressly that the first and last levels of the M levels are predetermined, wherein the first level is zero and the last level is the maximum possible level.

Ishiguro discloses that the first and last levels of the M levels are predetermined, wherein the first level (S0) is zero and the last level (S3) is the maximum possible level (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama in view of Revankar is combinable with Ishiguro because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a typical feature in images (column 2, lines 61-

63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama in view of Revankar to obtain the invention as specified in claim 18.

Regarding claim 24: Murayama in view of Revankar does not disclose expressly that the first and last levels of the M levels are predetermined.

Ishiguro discloses that the first and last levels of the M levels are predetermined (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama in view of Revankar is combinable with Ishiguro because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a common feature in images (column 2, lines 61-63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama in view of Revankar to obtain the invention as specified in claim 24.

6. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Merickel (US Patent 4,945,478), and Eschbach (US Patent 5,565,994).

Regarding claim 19: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one

percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar.

Murayama in view of Revankar and Merickel does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Revankar and Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform K-means clustering taught by Merickel and the multi-level error diffusion taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar and Merickel to obtain the invention as specified in claim 19.

7. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Merickel (US Patent 4,945,478), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claim 20: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one

percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar.

Murayama in view of Revankar and Merickel does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Revankar and Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform the K-means clustering taught by Merickel and the multi-level error diffusion taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar and Merickel.

Murayama in view of Revankar, Merickel and Eschbach does not disclose expressly that said multi-level error diffusion is specifically multi-level vector error diffusion.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar, Merickel and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar, Merickel and Eschbach to obtain the invention as specified in claim 20.

8. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Eschbach (US Patent 5,565,994).

Regarding claim 25: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and said setting, assigning, calculating, repeating, selecting and applying steps are performed independently on each of said multiple channels.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Revankar is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform said setting, assigning, calculating, repeating, selecting and applying steps, as taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar to obtain the invention as specified in claim 25.

9. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claim 26: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and said setting, assigning, calculating, repeating, selecting and applying steps are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Revankar is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform said setting, assigning, calculating, repeating, selecting and applying steps, as taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach),

separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar.

Murayama in view of Revankar and Eschbach does not disclose expressly that said multi-channel image space is specifically multi-channel vector space.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process, thus making said multi-channel image space specifically a multi-channel vector space. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar and Eschbach to obtain the invention as specified in claim 26.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

James A. Thompson
Examiner
Technology Division 2625

JAT
24 May 2007

David Moore

DAVID MOORE
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